



Gaseous Generator Set Installation and Case Studies

PowerHour webinar series for consulting engineers
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Meet your panelists

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Technical Marketing Specialist
Cummins Inc.

Cummins facilitator:



Chad Hale
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Disclaimer

The views and opinions expressed in this course shall not be considered the official position of any regulatory organization and shall not be considered to be, nor be relied upon as, a Formal Interpretation.

Participants are encouraged to refer to the entire text of all referenced documents. In addition, when in doubt, reach out to the Authority Having Jurisdiction.



Course Objectives

Gaseous Generator Set Installation and Case Studies

The specification and installation of gaseous generator sets continues to grow in North America in both emergency and non-emergency applications. Although the installation requirements differ only minimally from their diesel counterparts, it is important to understand the basics of gaseous generator sets to ensure they are specified appropriately. This course will explore a number of unique installations that feature gaseous generator sets and will highlight the need for gaseous fuel sources in these applications.

After completing this course, participants will be able to:

- List the basic installation requirements of gaseous generator sets.
- Recognize the broad range of capability of gaseous generator sets.
- Describe potential challenges and advantages of gaseous generator set installations.



What are some of the key installation requirements of natural gas generator sets?

Gaseous Generator Sets

Fuel Supply Basics

Primary factors impacting gaseous fuel system installations:



Gaseous Generator Sets

Fuel Supply Basics

Primary factors impacting gaseous fuel system installations:

1. The gas supplied to the generator set must be of **acceptable quality**.



Gaseous Generator Sets

Fuel Supply Basics

Primary factors impacting gaseous fuel system installations:

1. The gas supplied to the generator set must be of acceptable quality.
2. The gas supplied to the generator set must be of **sufficient pressure**.



Gaseous Generator Sets

Fuel Supply Basics

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1. The gas supplied to the generator set must be of acceptable quality.
2. The gas supplied to the generator set must be of sufficient pressure.
3. The gas supplied to the generator set must be available in **sufficient volume**.



Gaseous Generator Sets

Fuel Supply Basics

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1. The gas supplied to the generator set must be of **acceptable quality**.
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Gaseous Generator Sets

Fuel Supply Basics - Quality

| Category | Also Known As | BTU |
|----------------------------|--------------------------------|----------|
| Conventional Natural Gas | Pipeline Gas, Standard Gas | High |
| | Associated Petroleum Gas (APG) | High |
| | Flare Gas, Field Gas | High |
| | Associated-Dissolved Gas (ADG) | High |
| | Wellhead Gas | High |
| Unconventional Natural Gas | Coal Bed Methane (CBM) | High |
| | Coal Mine Methane (CMM) | ~Low |
| Biogas | Anaerobic Digester Gas (ADG) | Low |
| | Wastewater Treatment Plant Gas | Low |
| Syngas | Synthesis Gas, Pyrolysis Gas | Very Low |
| Industrial Gas | Town Gas | Very Low |

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Gaseous Generator Sets

Fuel Supply Basics - Quality



Exhaust Emission Data Sheet C150N6 60 Hz Spark Ignited Generator Set EPA Emissions

| | Propane (LP) | | | |
|--|----------------|----------------|----------------|--------------------------------------|
| | 1/4 | 1/2 | 3/4 | Full |
| Performance Data | Standby | Standby | Standby | Standby |
| BHP @ 1800 RPM (60 Hz) | 72.4 | 125.7 | 180.2 | 240.0 |
| Fuel Consumption (SCFH) | 288.4 | 438.5 | 596.3 | 783.0 |
| Exhaust Gas Flow (CFM) | 538.0 | 877.0 | 1176.0 | 1494.0 |
| Exhaust Gas Temperature (°F) | 1219.0 | 1298.0 | 1279.0 | 1236.0 |
| Air to Fuel Ratio | 21.1 | 22.1 | 22.7 | 23.3 |
| Exhaust Emission Data | | | | |
| HC (Total Unburned Hydrocarbons)* | 0.36 | 0.35 | 0.33 | 0.45 |
| NOx (Oxides of Nitrogen as NO ₂) | 1.49 | 1.28 | 1.38 | 1.23 |
| CO (Carbon Monoxide) | 3.21 | 2.46 | 2.10 | 2.14 |
| | | | | All values above are cited: g/BHP-hr |
| HC (Total Unburned Hydrocarbons)* | 153 | 163 | 159 | 215 |
| NOx (Oxides of Nitrogen as NO ₂) | 212 | 202 | 223 | 194 |
| CO (Carbon Monoxide) | 749 | 636 | 556 | 557 |
| | | | | All values above are cited: ppmv |

*HC includes NMHC, VOC, POC, and ROC constituents (Non-Methane HC, Volatile Organic Compounds, Precursor Organic Compounds and Reactive Organic Compounds).

| Test Conditions | |
|--|---|
| Test Conditions apply to both Natural Gas and Propane | |
| Data is representative of steady-state engine speed (± 25 RPM) with full load (±2%). Pressures, temperatures, and emission rates were stabilized. | |
| Fuel Specification: | Natural Gas: Dry gas received from Supplier (1000 BTU/SCF) Propane: Meets the requirements for Commercial Grade Propane under the ASTM D1835 Standard Specification for Liquefied Gases. |
| Fuel Inlet Temperature: | 60 ± 9 °F at flow transmitter |
| Fuel Pressure: | 14.73PSIA ± 0.5 PSIA at Flow Transmitter |
| Air Inlet Temperature: | 77 ± 9 °F |
| Barometric Pressure: | 22.92 ± 1 in. Hg |
| Humidity: | NOx measurement corrected to 75 grains H ₂ O/lb (10.7 g/kg) of dry air |
| The NOx, HC, CO and PM emission data tabulated here are representative of test data taken from a single engine under the test conditions shown above. These data are subjected to instrumentation and engine-to-engine variability. Field emission test data are not guaranteed to these levels. Actual field test results may vary due to test site conditions, installation, fuel specification, test procedures and instrumentation. Engine operation with excessive air intake or exhaust restriction beyond published maximum limits, or with improper maintenance, may result in elevated emission levels. | |

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Fuel Pressure:

14.73PSIA \pm 0.5 PSIA at Flow Transmitter

Air Inlet Temperature:

77 \pm 9 °F

Barometric Pressure:

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Humidity:

NOx measurement corrected to 75 grains H₂O/lb (10.7 g/kg) of dry air

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Spec Note Generator set manufacturer shall provide documentation indicating product performance at a specified fuel energy content or range based on site fuel sample analysis.

Gaseous Generator Sets

Fuel Supply Basics - Quality

Methane Index Number (MN)

- Defines likelihood of a fuel to auto-ignite
- Scale of 0-100

Gaseous Generator Sets

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 - Higher MN may be less likely to auto-ignite (knock) and may be suitable for high power density applications.
 - Lower MN may be more likely to auto-ignite (knock) and may require power derate and/or timing changes.

Methane number capability

| Load (percent of rated) | | | |
|-------------------------|-----|-----|-----|
| 100% | 90% | 75% | 50% |
| 72 | 66 | 57 | 42 |

Gaseous Generator Sets

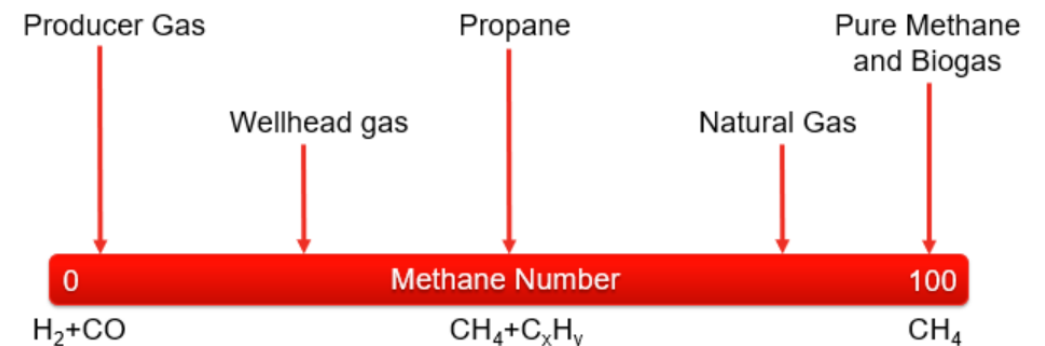
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Generator Set Data Sheet 2000 kW Standby



Model: C2000 N6B
Frequency: 60 Hz
Fuel Type: Natural Gas MI 65+
Emissions NOx: 1.0 g/bhp-hr
LT Water Inlet Temp: 40 °C (104 °F)
HT Water Outlet Temp: 92 °C (197 °F)

Measured sound performance data sheet: MSP-3063
Prototype test summary data: PTS-620
Remote radiator cooling outline: A057J589

| Fuel Consumption (ISO3046/1) | See Note | 100% of rated load | 90% of rated load | 75% of rated load | 50% of rated load |
|---|----------|--------------------|-------------------|-------------------|-------------------|
| Fuel consumption (LHV) ISO3046/1, kW (MMBTU/hr) | 2,4,6,7 | 5358 (18.3) | 4876 (16.65) | 4149 (14.17) | 2958 (10.1) |
| Mechanical efficiency ISO3046/1, percent | 2,4,7 | 39.8% | 39.4% | 38.6% | 36.1% |
| Electrical efficiency ISO3046/1, percent | 2,4,6,7 | 38.3% | 37.8% | 37.1% | 34.6% |

Engine

| | |
|---|------------------|
| Engine manufacturer | Cummins |
| Engine model | QSV91-G4 |
| Configuration | V18 |
| Displacement, L (cu.in) | 91.6 (5591) |
| Aspiration | Turbocharged (4) |
| Gross engine power output, kW (hp) | 2113 (2833) |
| BMEP, bar (psi) | 18.3 (265) |
| Bore, mm (in) | 180 (7.09) |
| Stroke, mm (in) | 200 (7.87) |
| Rated speed, rpm | 1514 |
| Piston speed, m/s (ft/min) | 10 (1968) |
| Compression ratio | 11.4:1 |
| Lube oil capacity, L (qt) | 582 (615) |
| Overspeed limit, rpm | 1800 |
| Regenerative power, kW | N/A |
| Full load lubricating oil consumption, g/kWh-hr (g/hp-hr) | 0.4 (0.3) |

Fuel

| | |
|--|------------|
| Minimum gas supply pressure at DMV, bar (psi) ⁷ | 0.24 (3.5) |
| Min methane index | 65 |

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Spec Note Generator set manufacturer shall provide documentation indicating product performance at a specified Methane Number or range based on site fuel sample analysis.

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|-------------------|
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Gaseous Generator Sets

Fuel Supply Basics - Pressure

- Pressure and volume must be available at **RATED** load.
- Be aware of fuel system pressure drop.
- Booster may be installed to raise pressure, if needed.
- Consult generator set manufacturer for specific fuel system requirements.

Fuel system

| | |
|---|-----------|
| Gas supply pressure to engine inlet, bar (psi) ⁸ | 0.2 (2.9) |
| Minimum methane index | 62 |



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Related Content

Gaseous Fuel System Sizing

[T-030: Liquid-Cooled Generator Set Application Manual](#)

[T-035: Gas Power Plant Application Manual](#)

Fuel system

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| Gas supply pressure to engine inlet, bar (psi) ⁸ | 0.2 (2.9) |
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Gaseous Generator Sets

Fuel Supply Basics – Volume

Generator Set Data Sheet



Model: C150N6
Frequency: 60 Hz
Fuel type: Natural gas
KW rating: 150 Natural gas standby

Emissions level: EPA Emissions

| Fuel consumption | Natural gas Standby | | | | Propane Standby | | | |
|----------------------|---------------------|--------|--------|--------|-----------------|-------|-------|-------|
| | kW (kVA) | | | | | | | |
| Ratings ^a | 150 (188) | | | | 150 (188) | | | |
| Load | 1/4 | 1/2 | 3/4 | Full | 1/4 | 1/2 | 3/4 | Full |
| scfh | 718.7 | 1111.3 | 1487.2 | 1915.0 | 288.4 | 438.5 | 596.3 | 783.0 |
| m ³ /hr | 20.35 | 31.47 | 42.12 | 54.3 | 8.17 | 12.42 | 16.89 | 22.2 |

| Engine | Natural gas Standby Rating | Propane Standby Rating |
|-------------------------------------|---------------------------------|------------------------|
| Engine model | Q5J8.9G | |
| Configuration | Cast iron, in line, 6 cylinders | |
| Aspiration | Turbocharged and aftercooled | |
| Gross engine power output, kW (bhp) | 179 (240) | |
| Bore, mm (in) | 114.1 (4.49) | |
| Stroke, mm (in) | 144.5 (5.69) | |
| Rated speed, rpm | 1800 | |
| Compression ratio | 9.7:1 | |
| Lube oil capacity, L (qt) | 20.8 (22) | |

| Fuel supply pressure | Natural gas Standby Rating | Propane Standby Rating |
|---|----------------------------|------------------------|
| Minimum operating pressure, kPa (in H ₂ O) | 1.5 (6) | |
| Maximum operating pressure, kPa (in H ₂ O) | 3.5 (13) | |

| Air | Natural gas Standby Rating | Propane Standby Rating |
|--|----------------------------|------------------------|
| Combustion air, m ³ /min (scfm) | 13.7 (483) | |
| Maximum normal duty air cleaner restriction, kPa (in H ₂ O) | 0.37 (1.5) | |
| Maximum heavy-duty air cleaner restriction, kPa (in H ₂ O) | 3.7 (15.0) | |

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| Regenerative power, kW | N/A |
| Full load lubricating oil consumption, g/kWh-hr (g/tp-hr) | 0.4 (0.3) |

| Fuel | |
|--|------------|
| Minimum gas supply pressure at DMV, bar (psi) ² | 0.24 (3.5) |
| Min methane index | 65 |

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Gaseous Generator Sets

Fuel Supply Basics – Volume

Generator Set Data Sheet



Model: C150N6
 Frequency: 60 Hz
 Fuel type: Natural gas
 kW rating: 150 Natural gas standby

Emissions level: EPA Emissions

| Fuel consumption | Natural gas Standby | | | | Propane Standby | | | |
|--------------------|---------------------|--------|--------|--------|-----------------|-------|-------|-------|
| | kW (kVA) | | | | | | | |
| Ratings | 150 (188) | | | | | | | |
| Load | 1/4 | 1/2 | 3/4 | Full | 1/4 | 1/2 | 3/4 | Full |
| scfh | 718.7 | 1111.3 | 1487.2 | 1915.0 | 288.4 | 438.5 | 596.3 | 783.0 |
| m ³ /hr | 20.35 | 31.47 | 42.12 | 54.3 | 8.17 | 12.42 | 16.89 | 22.2 |

| Engine | Natural gas Standby Rating | Propane Standby Rating |
|-------------------------------------|---------------------------------|------------------------|
| Engine model | QSJ8.9G | |
| Configuration | Cast iron, in line, 6 cylinders | |
| Aspiration | Turbocharged and aftercooled | |
| Gross engine power output, kW (bhp) | 179 (240) | |
| Bore, mm (in) | 114.1 (4.49) | |
| Stroke, mm (in) | 144.5 (5.69) | |

| Fuel consumption | Natural gas Standby | | | | Propane Standby | | | |
|--------------------|---------------------|--------|--------|--------|-----------------|-------|-------|-------|
| | kW (kVA) | | | | | | | |
| Ratings | 150 (188) | | | | | | | |
| Load | 1/4 | 1/2 | 3/4 | Full | 1/4 | 1/2 | 3/4 | Full |
| scfh | 718.7 | 1111.3 | 1487.2 | 1915.0 | 288.4 | 438.5 | 596.3 | 783.0 |
| m ³ /hr | 20.35 | 31.47 | 42.12 | 54.3 | 8.17 | 12.42 | 16.89 | 22.2 |

Maximum heavy-duty air cleaner restriction, kPa (in H₂O) 3.7 (15.0)

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Generator Set Data Sheet 2000 kW Standby



Model: C2000 N6B
 Frequency: 60 Hz
 Fuel Type: Natural Gas MI 65+
 Emissions NOx: 1.0 g/bhp-hr
 LT Water Inlet Temp: 40 °C (104 °F)
 HT Water Outlet Temp: 92 °C (197 °F)

| | | | | | |
|---|----------|--------------------|-------------------|-------------------|-------------------|
| Measured sound performance data sheet: | MSP-3063 | | | | |
| Prototype test summary data: | PTS-620 | | | | |
| Remote radiator cooling outline: | A057589 | | | | |
| Fuel Consumption (ISO3046/1) | See Note | 100% of rated load | 90% of rated load | 75% of rated load | 50% of rated load |
| Fuel consumption (LHV) ISO3046/1, kW (MMBtu/hr) | 2,4,6,7 | 5358 (18.3) | 4876 (16.65) | 4149 (14.17) | 2958 (10.1) |
| Mechanical efficiency ISO3046/1, percent | 2,4,7 | 39.8% | 39.4% | 38.6% | 38.1% |
| Electrical efficiency ISO3046/1, percent | 2,4,6,7 | 38.3% | 37.8% | 37.1% | 34.6% |

| Engine | |
|---|------------------|
| Engine manufacturer | Cummins |
| Engine model | QSV91-G4 |
| Configuration | V18 |
| Displacement, L (cu.in) | 91.6 (5591) |
| Aspiration | Turbocharged (4) |
| Gross engine power output, kW (hp) | 2113 (2833) |
| BMEP, bar (psi) | 18.3 (265) |
| Bore, mm (in) | 180 (7.09) |
| Stroke, mm (in) | 200 (7.87) |
| Rated speed, rpm | 1514 |
| Piston speed, m/s (ft/min) | 10 (1968) |
| Compression ratio | 11.4:1 |
| Lube oil capacity, L (qt) | 582 (615) |
| Overspeed limit, rpm | 1800 |
| Regenerative power, kW | N/A |
| Full load lubricating oil consumption, g/kWh-hr (g/tp-hr) | 0.4 (0.3) |

| Fuel | |
|--|------------|
| Minimum gas supply pressure at DMV, bar (psi) ¹ | 0.24 (3.5) |
| Min methane index | 65 |

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Gaseous Generator Sets

Fuel Supply Basics – Volume

Generator Set Data Sheet



Model: C150N6
 Frequency: 60 Hz
 Fuel type: Natural gas
 kW rating: 150 Natural gas standby

Emissions level: EPA Emissions

| Fuel consumption | Natural gas Standby | | | | Propane Standby | | | |
|--------------------|---------------------|--------|--------|--------|-----------------|-------|-------|-------|
| | kW (kVA) | | | | | | | |
| Ratings | 150 (188) | | | | | | | |
| Load | 1/4 | 1/2 | 3/4 | Full | 1/4 | 1/2 | 3/4 | Full |
| scfh | 718.7 | 1111.3 | 1487.2 | 1915.0 | 288.4 | 438.5 | 596.3 | 783.0 |
| m ³ /hr | 20.35 | 31.47 | 42.12 | 54.3 | 8.17 | 12.42 | 16.89 | 22.2 |

| Engine | Natural gas Standby Rating | Propane Standby Rating |
|-------------------------------------|---------------------------------|------------------------|
| Engine model | QSK19.9G | |
| Configuration | Cast iron, in line, 6 cylinders | |
| Aspiration | Turbocharged and aftercooled | |
| Gross engine power output, kW (bhp) | 179 (240) | |
| Bore, mm (in) | 114.1 (4.49) | |
| Stroke, mm (in) | 144.5 (5.69) | |

| Fuel consumption | Natural gas Standby | | | | Propane Standby | | | |
|--------------------|---------------------|--------|--------|--------|-----------------|-------|-------|-------|
| | kW (kVA) | | | | | | | |
| Ratings | 150 (188) | | | | | | | |
| Load | 1/4 | 1/2 | 3/4 | Full | 1/4 | 1/2 | 3/4 | Full |
| scfh | 718.7 | 1111.3 | 1487.2 | 1915.0 | 288.4 | 438.5 | 596.3 | 783.0 |
| m ³ /hr | 20.35 | 31.47 | 42.12 | 54.3 | 8.17 | 12.42 | 16.89 | 22.2 |

Propane Standby Rating
13.9 (490)

Maximum heavy-duty air cleaner restriction, kPa (in H₂O) 3.7 (15.0)

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Generator Set Data Sheet 2000 kW Standby



Model: C2000 N6B
 Frequency: 60 Hz
 Fuel Type: Natural Gas MI 65+
 Emissions NOx: 1.0 g/bhp-hr
 LT Water Inlet Temp: 40 °C (104 °F)
 HT Water Outlet Temp: 92 °C (197 °F)

Measured sound performance data sheet: MSP-3063
 Prototype test summary data: PTS-620
 Remote radiator cooling outline: A057589

| Fuel Consumption (ISO3046/1) | See Note | 100% of rated load | 90% of rated load | 75% of rated load | 50% of rated load |
|---|----------|--------------------|-------------------|-------------------|-------------------|
| Fuel consumption (LHV) ISO3046/1, kW (MMBTU/hr) | 2,4,6,7 | 5358 (18.3) | 4876 (16.65) | 4149 (14.17) | 2958 (10.1) |
| Mechanical efficiency ISO3046/1, percent | 2,4,7 | 39.8% | 39.4% | 38.6% | 36.1% |
| Electrical efficiency ISO3046/1, percent | 2,4,6,7 | 38.3% | 37.8% | 37.1% | 34.6% |

| | |
|------------------------------------|------------------|
| Engine manufacturer | Cummins |
| Engine model | QSV91-G4 |
| Configuration | V18 |
| Displacement, L (cu.in) | 91.6 (5591) |
| Aspiration | Turbocharged (4) |
| Gross engine power output, kW (hp) | 2113 (2833) |
| BMEP, bar (psi) | 18.3 (265) |

| Fuel Consumption (ISO3046/1) | See Note | 100% of rated load | 90% of rated load | 75% of rated load | 50% of rated load |
|---|----------|--------------------|-------------------|-------------------|-------------------|
| Fuel consumption (LHV) ISO3046/1, kW (MMBTU/hr) | 2,4,6,7 | 5358 (18.3) | 4876 (16.65) | 4149 (14.17) | 2958 (10.1) |
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Gaseous Generator Sets

Fuel Supply Basics – Volume

Generator Set Data Sheet



Model: C150N6
 Frequency: 60 Hz
 Fuel type: Natural gas
 kW rating: 150 Natural gas standby

Emissions level: EPA Emissions

| Fuel consumption | Natural gas Standby | | | | Propane Standby | | | |
|--------------------|---------------------|--------|--------|--------|-----------------|-------|-------|-------|
| | kW (kVA) | | | | | | | |
| Ratings | 150 (188) | | | | | | | |
| Load | 1/4 | 1/2 | 3/4 | Full | 1/4 | 1/2 | 3/4 | Full |
| scfh | 718.7 | 1111.3 | 1487.2 | 1915.0 | 288.4 | 438.5 | 596.3 | 783.0 |
| m ³ /hr | 20.35 | 31.47 | 42.12 | 54.3 | 8.17 | 12.42 | 16.89 | 22.2 |

| Engine | Natural gas Standby Rating | Propane Standby Rating |
|-------------------------------------|---------------------------------|------------------------|
| Engine model | QSK38.9G | |
| Configuration | Cast iron, in line, 6 cylinders | |
| Aspiration | Turbocharged and aftercooled | |
| Gross engine power output, kW (bhp) | 179 (240) | |
| Bore, mm (in) | 114.1 (4.49) | |
| Stroke, mm (in) | 144.5 (5.69) | |

| Fuel consumption | Natural gas Standby | | | | Propane Standby | | | |
|--------------------|---------------------|--------|--------|--------|-----------------|-------|-------|-------|
| | kW (kVA) | | | | | | | |
| Ratings | 150 (188) | | | | | | | |
| Load | 1/4 | 1/2 | 3/4 | Full | 1/4 | 1/2 | 3/4 | Full |
| scfh | 718.7 | 1111.3 | 1487.2 | 1915.0 | 288.4 | 438.5 | 596.3 | 783.0 |
| m ³ /hr | 20.35 | 31.47 | 42.12 | 54.3 | 8.17 | 12.42 | 16.89 | 22.2 |

Maximum heavy-duty air cleaner restriction, kPa (in H₂O) 3.7 (15.0)

Generator Set Data Sheet
 2000 kW Standby



Model: C2000 N6B
 Frequency: 60 Hz
 Fuel Type: Natural Gas MI 65+
 Emissions NOx: 1.0 g/bhp-hr
 LT Water Inlet Temp: 40 °C (104 °F)
 HT Water Outlet Temp: 92 °C (197 °F)

Measured sound performance data sheet: MSP-3063
 Prototype test summary data: PTS-620
 Remote radiator cooling outline: A057389

| Fuel Consumption (ISO3046/1) | See Note | 100% of rated load | 90% of rated load | 75% of rated load | 50% of rated load |
|---|----------|--------------------|-------------------|-------------------|-------------------|
| Fuel consumption (LHV) ISO3046/1, kW (MMBTU/hr) | 2,4,6,7 | 5358 (18.3) | 4876 (16.65) | 4149 (14.17) | 2958 (10.1) |
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| | |
|------------------------------------|------------------|
| Engine manufacturer | Cummins |
| Engine model | QSV91-G4 |
| Configuration | V18 |
| Displacement, L (cu.in) | 91.6 (5591) |
| Aspiration | Turbocharged (4) |
| Gross engine power output, kW (hp) | 2113 (2833) |
| BMEP, bar (psi) | 18.3 (265) |

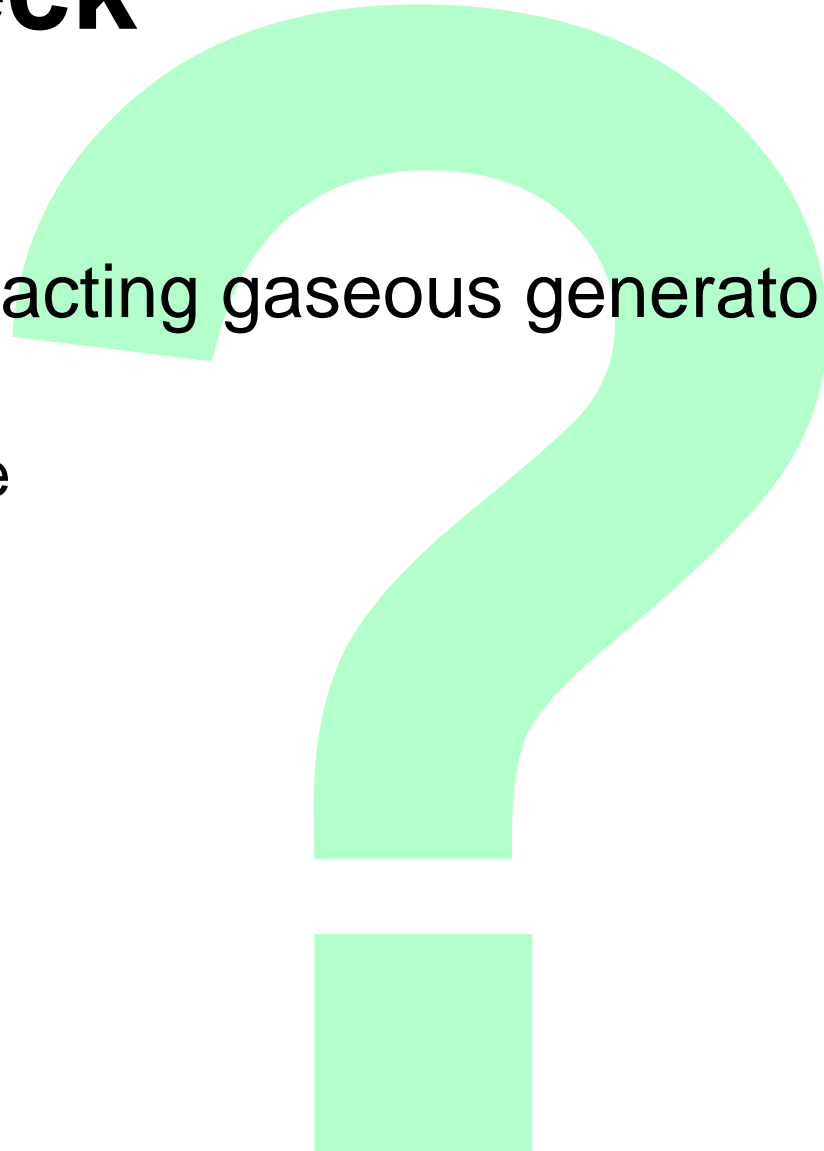
| Fuel Consumption (ISO3046/1) | See Note | 100% of rated load | 90% of rated load | 75% of rated load | 50% of rated load |
|---|----------|--------------------|-------------------|-------------------|-------------------|
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| Mechanical efficiency ISO3046/1, percent | 2,4,7 | 39.8% | 39.4% | 38.6% | 36.1% |
| Electrical efficiency ISO3046/1, percent | 2,4,6,7 | 38.3% | 37.8% | 37.1% | 34.6% |

Spec Note Generator set manufacturer shall provide documentation indicating maximum fuel consumption at rated load.

Concept Check

Three key factors impacting gaseous generator set installation include:

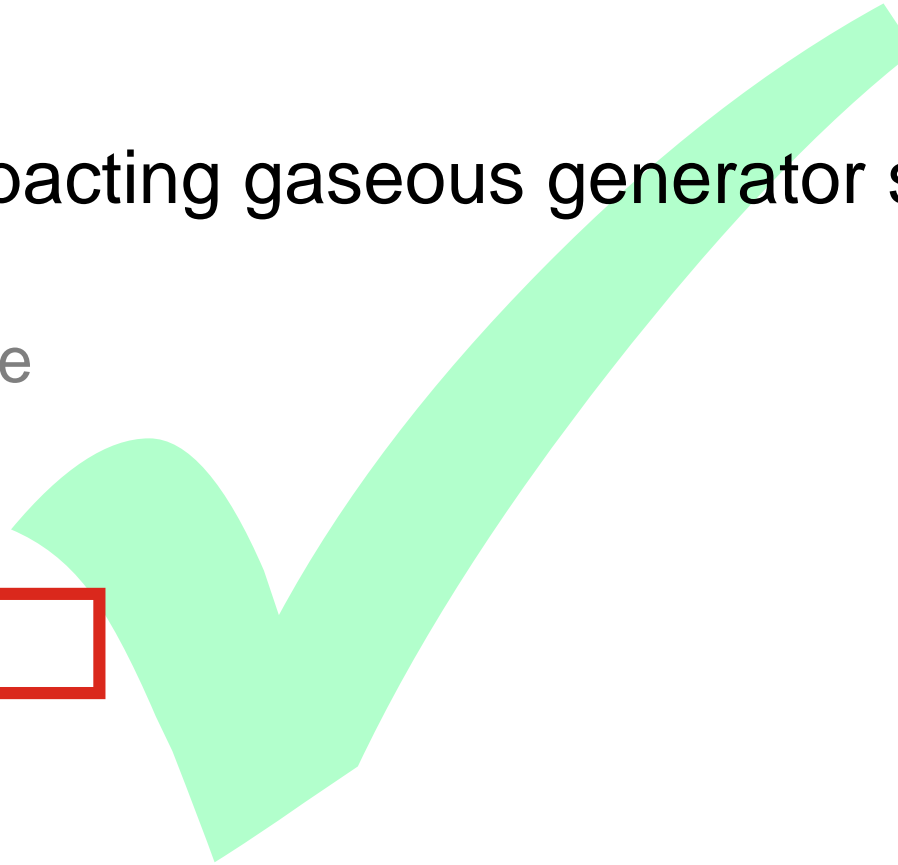
- a) Gas Supply Pressure
- b) Gas Supply Volume
- c) Gas Supply Quality
- d) All of the Above



Concept Check

Three key factors impacting gaseous generator set installation include:

- a) Gas Supply Pressure
- b) Gas Supply Volume
- c) Gas Supply Quality
- d) All of the Above



Gaseous Generator Sets

Installation Considerations

- Natural gas is available through extensive and reliable pipeline network.
- Natural gas pipeline avoids fuel transportation, handling and storage issues associated with on-site fuel storage.
 - No fuel tank cleaning required.
 - Limited degradation of fuel over time.
 - No requirement for regular fuel testing.
- Can be easily backed-up with on-site fuel storage (LNG or LPG).



Gaseous Generator Sets

Installation Considerations

- Natural gas is available through extensive and reliable pipeline network.
- Natural gas pipeline avoids fuel transportation, handling and storage issues associated with on-site fuel storage.
 - No fuel tank cleaning required.
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 - No requirement for regular fuel testing.
- Can be easily backed-up with on-site fuel storage (LNG or LPG).

Related Content

Considerations for Specifying Generator Set Fuel Sources

[On-Demand PowerHour Recording](#)

Gaseous Generator Sets

Compliance and Reliability

NFPA 110-2019

5.1.1 The following energy sources shall be permitted to be used for the emergency power supply (EPS):

- (1) Liquid petroleum products...
- (2) Liquefied petroleum gas...
- (3) Natural or synthetic gas

Gaseous Generator Sets

Compliance and Reliability

NFPA 110-2019

5.1.1 The following energy sources shall be permitted to be used for the emergency power supply (EPS):

- (1) Liquid petroleum products...
- (2) Liquified petroleum gas...
- (3) Natural or synthetic gas

Exception: For Level 1 installations in locations where the probability of interruption of off-site fuel supplies is high, on-site storage of an alternate energy source sufficient to allow full output of the EPSS to be delivered for the class specified shall be required, with the provision for automatic transfer from the primary energy source to the alternate energy source.

Gaseous Generator Sets

Compliance and Reliability

NFPA 110-2019

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Natural Gas Council

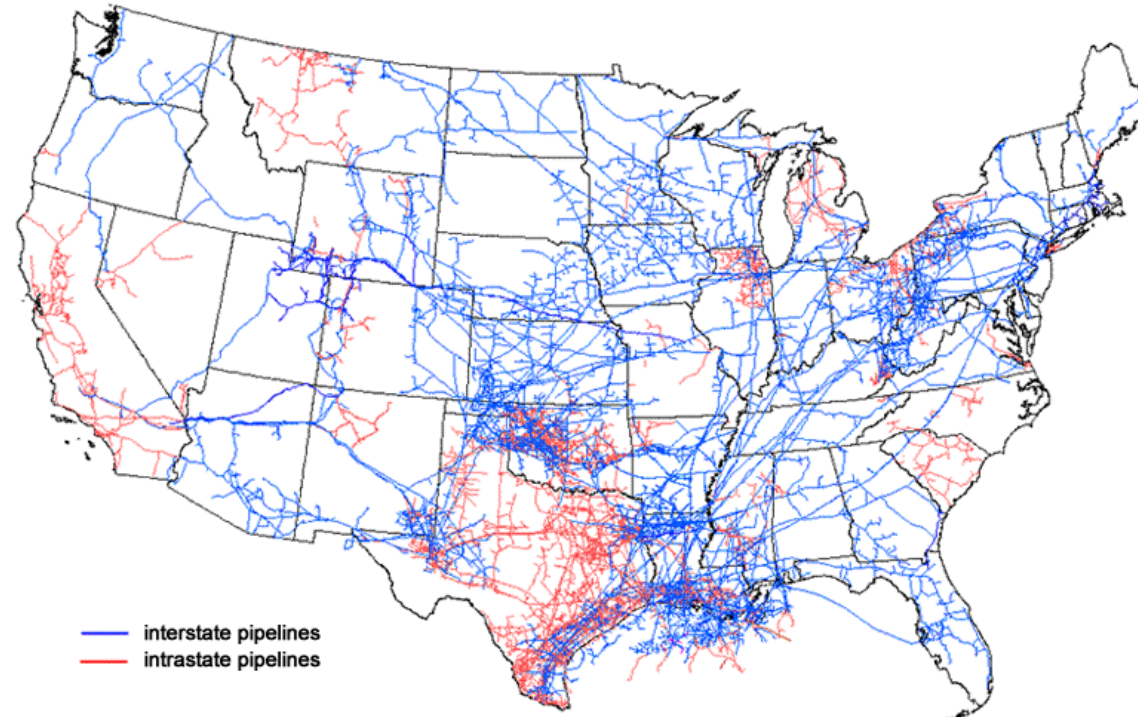
Natural gas is a secure, reliable and resilient choice for customers

- Operational reliability
 - 2017 survey of 51 interstate pipelines – 99.97% of contractual commitments
 - Geographic dispersion of production reduces vulnerability to local weather
 - Transportation network interconnected, offering multiple pathways for rerouting
- Contractual continuity of service
 - Firm or interruptible contracts

Gaseous Generator Sets

Compliance and Reliability

Map of U.S. interstate and intrastate natural gas pipelines

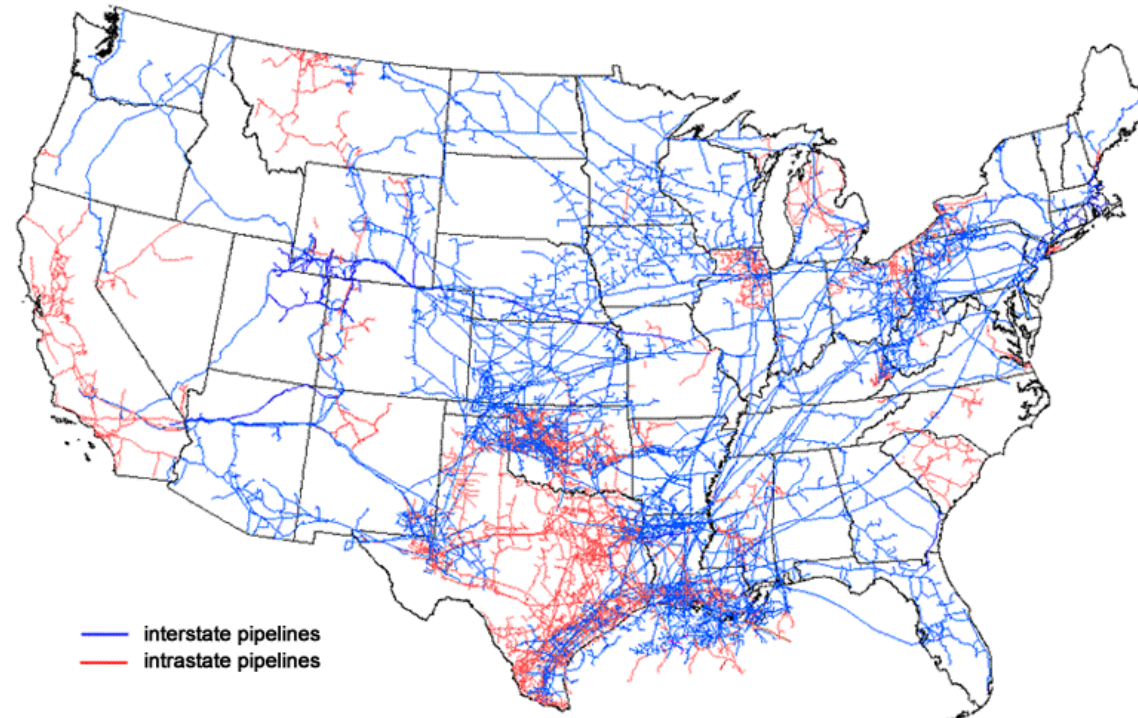


Source: U.S. Energy Information Administration, *About U.S. Natural Gas Pipelines*

Gaseous Generator Sets

Compliance and Reliability

Map of U.S. interstate and intrastate natural gas pipelines

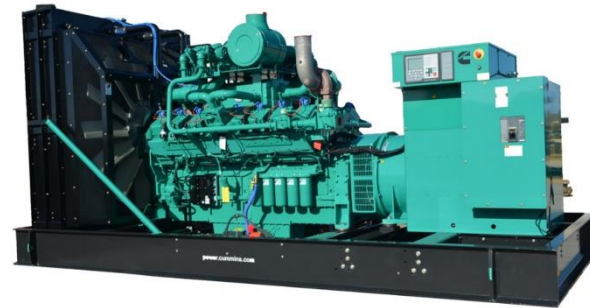


Source: U.S. Energy Information Administration, *About U.S. Natural Gas Pipelines*

Spec Note Specify natural-gas fueled generator sets for emergency power systems where permitted by the local Authority Having Jurisdiction.

Gaseous Generator Sets

Applications and Capability



Gaseous Generator Sets

Installation Review

Application: Standby and Demand Response

Segment: Wastewater Treatment Plant

Location: Wisconsin, US

Key Acceptance Criteria

- 1500 kWe Installed Capacity
- Extended Run Time with Limited On-Site Storage Capacity
- NFPA 110 Type 10 Starting
- 100% Nameplate Load Acceptance

Gaseous Generator Sets

Installation Review

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- NFPA 110 Type 10 Starting
- 100% Nameplate Load Acceptance

EPA Certified stationary non-emergency.
Capable of extended grid paralleling.

Related Content

EPA Emissions and Air Permitting
[On-Demand PowerHour Recording](#)

Gaseous Generator Sets

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Capable of extended grid paralleling.

Large single generator set or
multiple paralleled units.

Related Content

**Paralleling Power System Design and
System Level Control**
[On-Demand PowerHour Recording](#)

Gaseous Generator Sets

Installation Review

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Large single generator set or
multiple paralleled units.

On-site fuel storage limits
usage of diesel generator sets.

Gaseous Generator Sets

Installation Review

Application: Standby and Demand Response

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EPA Certified stationary non-emergency.
Capable of extended grid paralleling.

Large single generator set or
multiple paralleled units.

On-site fuel storage limits
usage of diesel generator sets.

Challenging for some spark-
ignited engines.

Related
Content

**NFPA 110 Type 10 Requirements for
Emergency Power Systems**
[On-Demand PowerHour Recording](#)

Gaseous Generator Sets

Installation Review

Application: Standby and Demand Response

Segment: Wastewater Treatment Plant

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Challenging for some spark-
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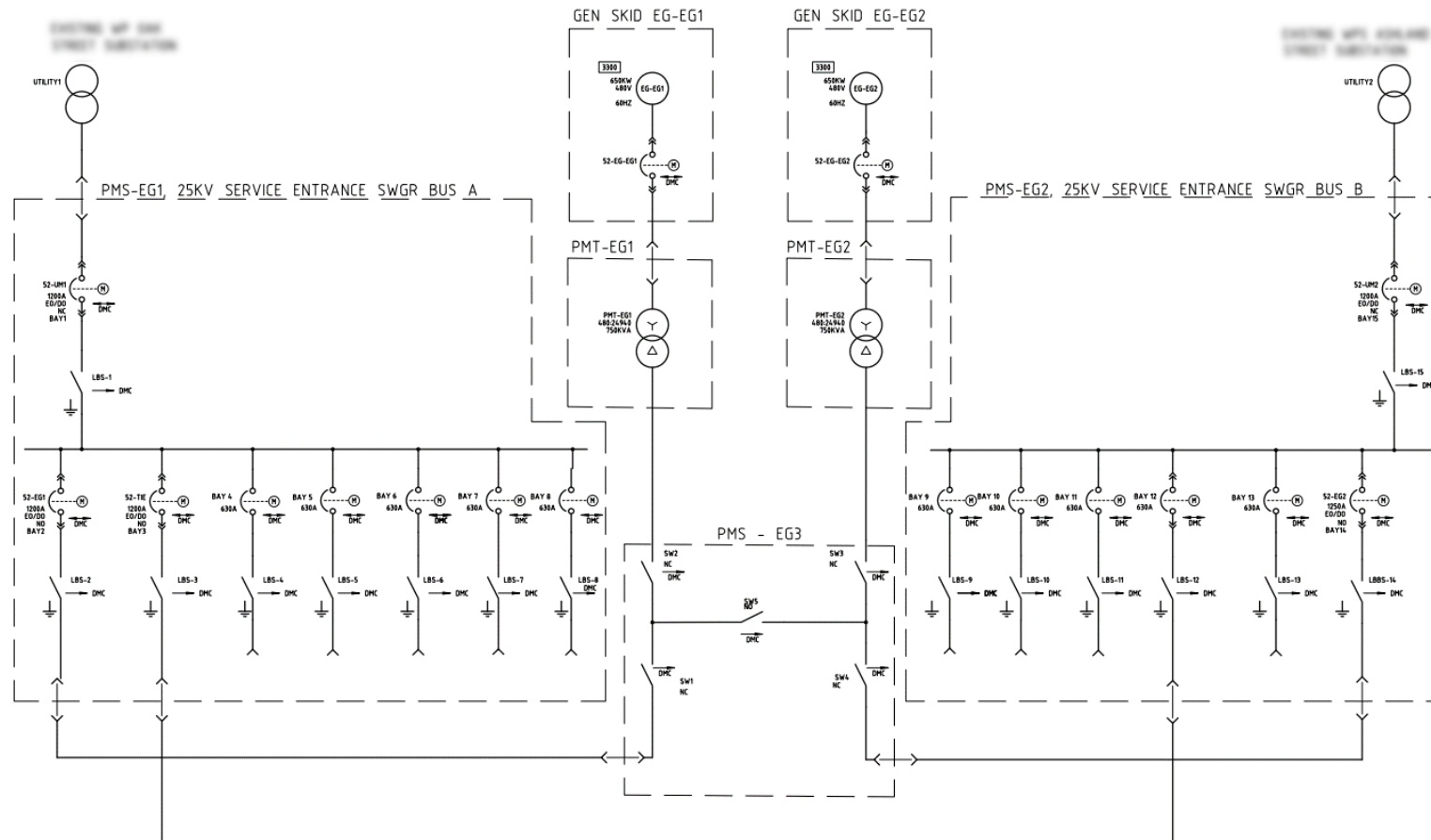
Related Content

**An Introduction to Generator Set Sizing
Software**

[On-Demand PowerHour Recording](#)

Gaseous Generator Sets

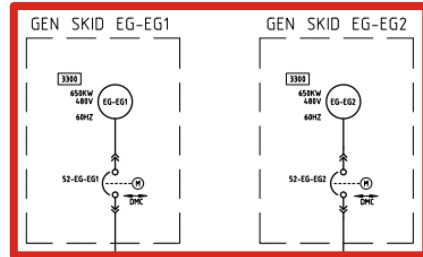
Installation Review



Gaseous Generator Sets

Installation Review

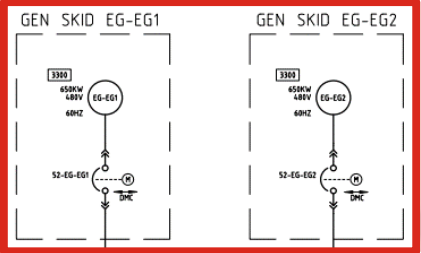
2 x Cummins C650N6 DR
750 kWe Standby
650 kWe Demand Response
On-Board Paralleling Controls



Gaseous Generator Sets

Installation Review

2 x Cummins C650N6 DR
750 kWe Standby
650 kWe Demand Response
On-Board Paralleling Controls



Cummins Digital Master Control
Main-Tie-Main System Topology
Extended Utility Paralleling
Allen Bradley PLC

Gaseous Generator Sets

Installation Review

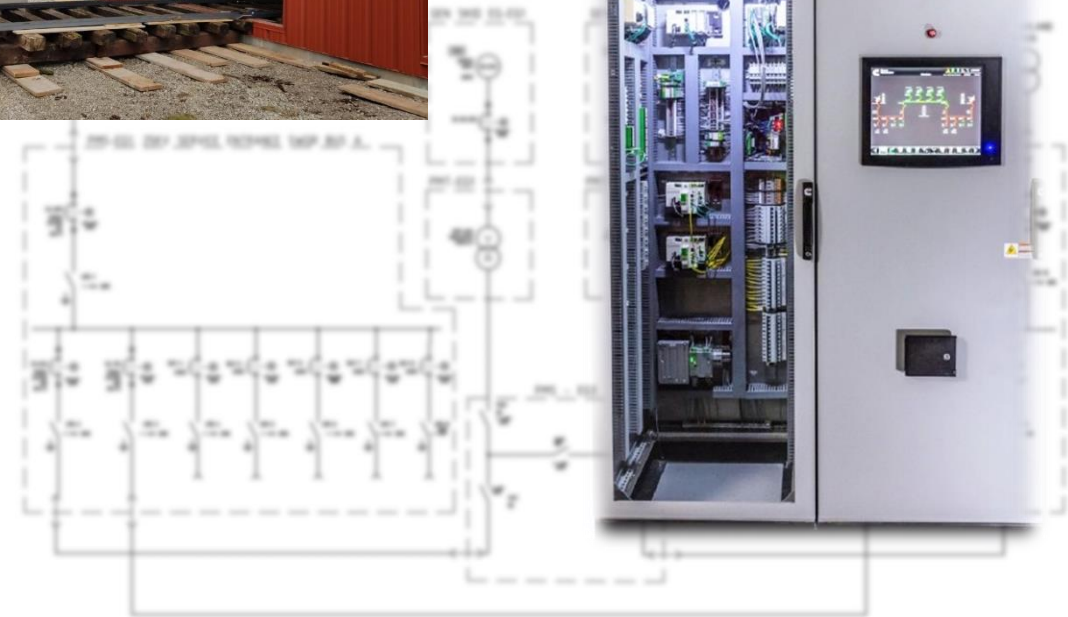
Application: Standby and Demand Response

Segment: Wastewater Treatment Plant

Location: Wisconsin, US

Key Acceptance Criteria

- ✓ 1500 kWe Installed Capacity
- ✓ Extended Run Time with Limited On-Site Storage Capacity
- ✓ NFPA 110 Type 10 Starting
- ✓ 100% Nameplate Load Acceptance



Related
Content

Case Studies

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Gaseous Generator Sets

Installation Review

Application: Standby and Hurricane Relief

Segment: Medical Center (763 Licensed Beds)

Location: Louisiana, US

Key Acceptance Criteria

- NFPA 110 Type 10 Starting for Life Safety Loads
- Extended Run Time (>24 Hours)
- Operational Flexibility

Gaseous Generator Sets

Installation Review


Application: Standby and Hurricane Relief

Segment: Medical Center (763 Licensed Beds)

Location: Louisiana, US

Key Acceptance Criteria

- NFPA 110 Type 10 Starting for Life Safety Loads
- Extended Run Time (>24 Hours)
- Operational Flexibility



High operating cost to power optional loads throughout extended outage.

Related Content

Considerations for Specifying Generator Set Fuel Sources

[On-Demand PowerHour Recording](#)

Gaseous Generator Sets

Installation Review

Application: Standby and Hurricane Relief

Segment: Medical Center (763 Licensed Beds)

Location: Louisiana, US

Key Acceptance Criteria

- NFPA 110 Type 10 Starting for Life Safety Loads
- Extended Run Time (>24 Hours)
- Operational Flexibility

High operating cost to power optional loads throughout extended outage.

Operational reliability needs limit reliance on fuel storage and delivery.

Related
Content

Considerations for Specifying Generator Set Fuel Sources

[On-Demand PowerHour Recording](#)

Gaseous Generator Sets

Installation Review

Application: Standby and Hurricane Relief

Segment: Medical Center (763 Licensed Beds)

Location: Louisiana, US

Key Acceptance Criteria

- NFPA 110 Type 10 Starting for Life Safety Loads
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- Operational Flexibility

High operating cost to power optional loads throughout extended outage.

Operational reliability needs limit reliance on fuel storage and delivery.

EPA Certified stationary non-emergency.
Capable of extended grid paralleling.

Related
Content

EPA Emissions and Air Permitting
[On-Demand PowerHour Recording](#)

Gaseous Generator Sets

Installation Review

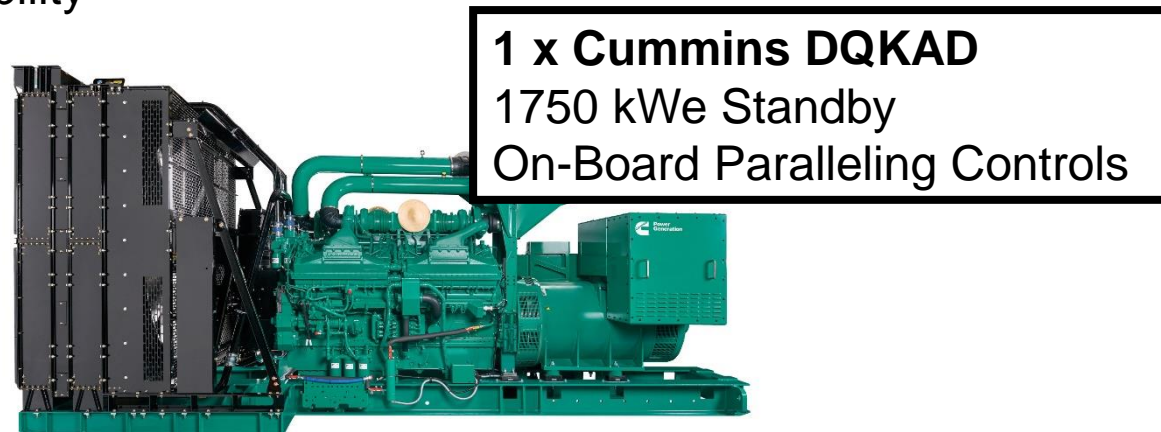
Application: Standby and Hurricane Relief

Segment: Medical Center (763 Licensed Beds)

Location: Louisiana, US

Key Acceptance Criteria

- ✓ NFPA 110 Type 10 Starting for Life Safety Loads
- Extended Run Time (>24 Hours)
- Operational Flexibility



Gaseous Generator Sets

Installation Review

Application: Standby and Hurricane Relief

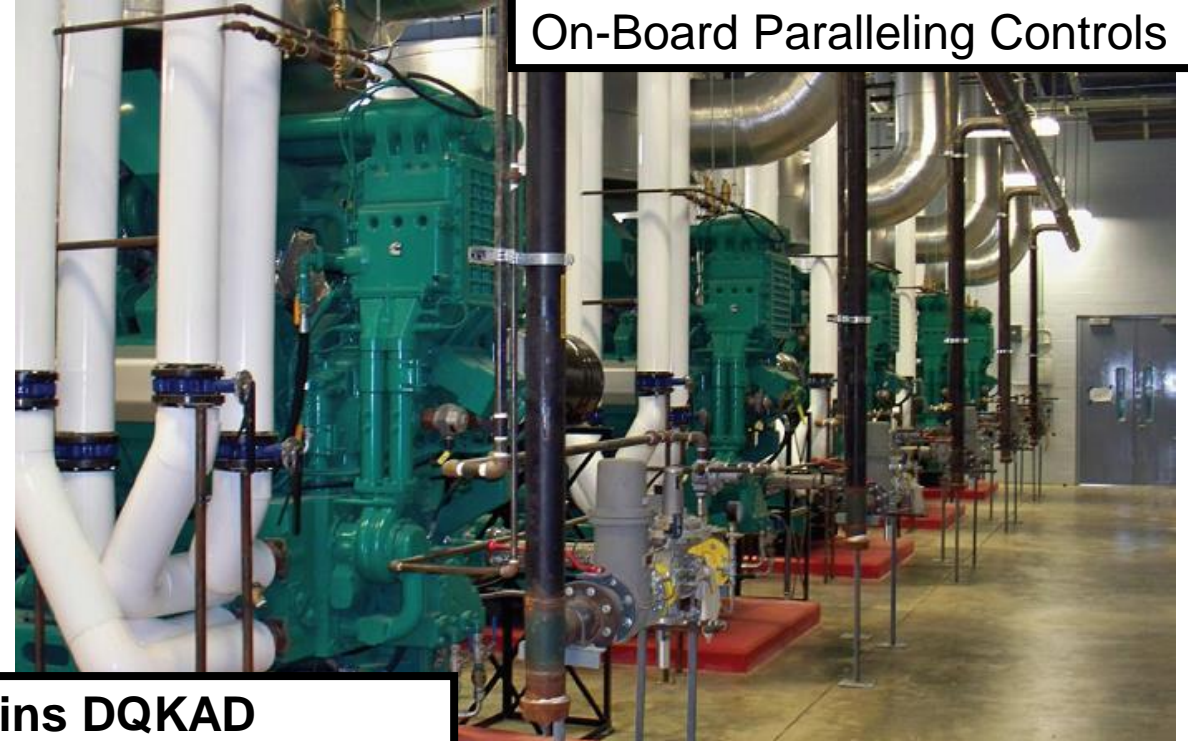
Segment: Medical Center (763 Licensed Beds)

Location: Louisiana, US

Key Acceptance Criteria

- ✓ NFPA 110 Type 10 Starting for Life Safety Loads
- ✓ Extended Run Time (>24 Hours)
- ✓ Operational Flexibility

4 x Cummins C1750N6CB
1750 kWe Continuous
On-Board Paralleling Controls



1 x Cummins DQKAD
1750 kWe Standby
On-Board Paralleling Controls



Gaseous Generator Sets

Installation Review

Application: Standby and Hurricane Relief

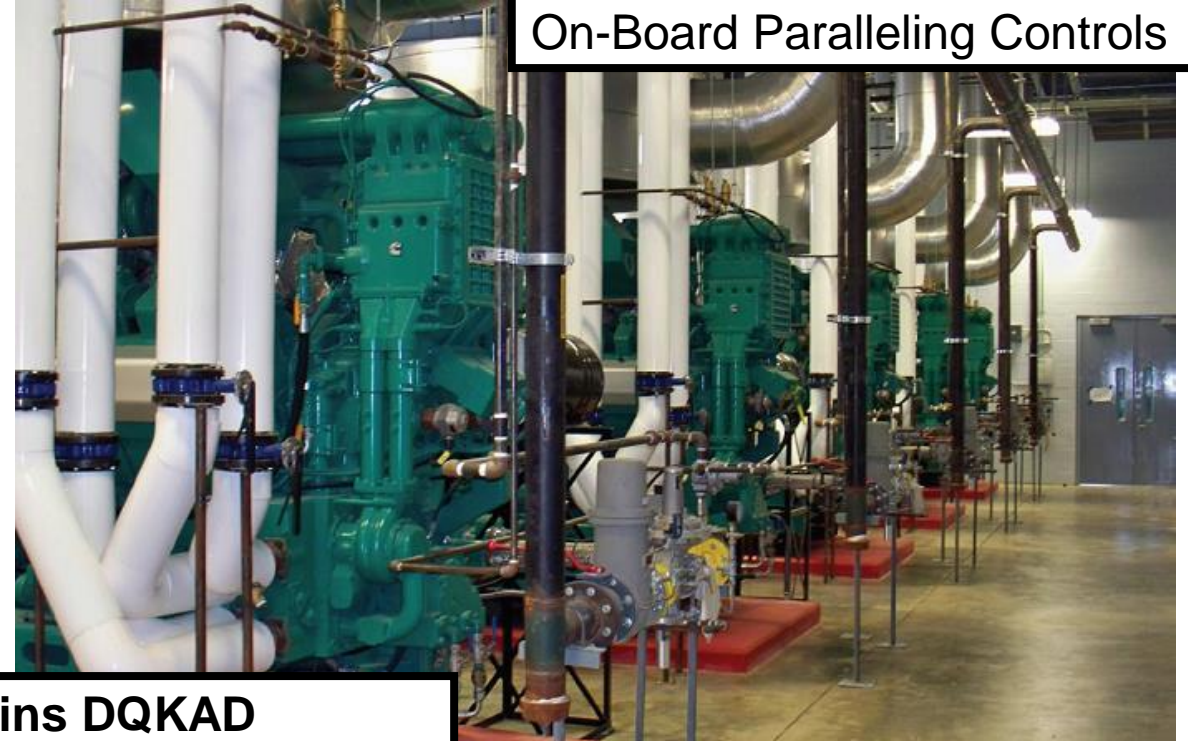
Segment: Medical Center (763 Licensed Beds)

Location: Louisiana, US

Key Acceptance Criteria

- ✓ NFPA 110 Type 10 Starting for Life Safety Loads
- ✓ Extended Run Time (>24 Hours)
- ✓ Operational Flexibility

4 x Cummins C1750N6CB
1750 kWe Continuous
On-Board Paralleling Controls



1 x Cummins DQKAD
1750 kWe Standby
On-Board Paralleling Controls



Related
Content

[Case Study](#)

Concept Check

When recommending the preferred fuel source for on-site power generation, which of the following project or site requirements should be considered?

- a) NFPA 110 Type requirements (Life Safety loads)
- b) Extended outage operation
- c) Operational flexibility (non-emergency usage)
- d) On-site fuel storage limitations
- e) All of the above

Concept Check

When recommending the preferred fuel source for on-site power generation, which of the following project or site requirements should be considered?

- a) NFPA 110 Type requirements (Life Safety loads)
- b) Extended outage operation
- c) Operational flexibility (non-emergency usage)
- d) On-site fuel storage limitations
- e) All of the above**

Course Summary

Gaseous Generator Set Installation and Case Studies

- List the basic installation requirements of gaseous generator sets.
- Recognize the broad range of capability of gaseous generator sets.
- Describe potential challenges and advantages of gaseous generator set installations.

Specify:

- Project performance requirements based on the application limitations (loads, power factor, transient limits, emissions, start-time and other code-driven requirements).
- Gaseous generator sets in emergency and non-emergency applications when appropriate and permitted by the authority having jurisdiction.

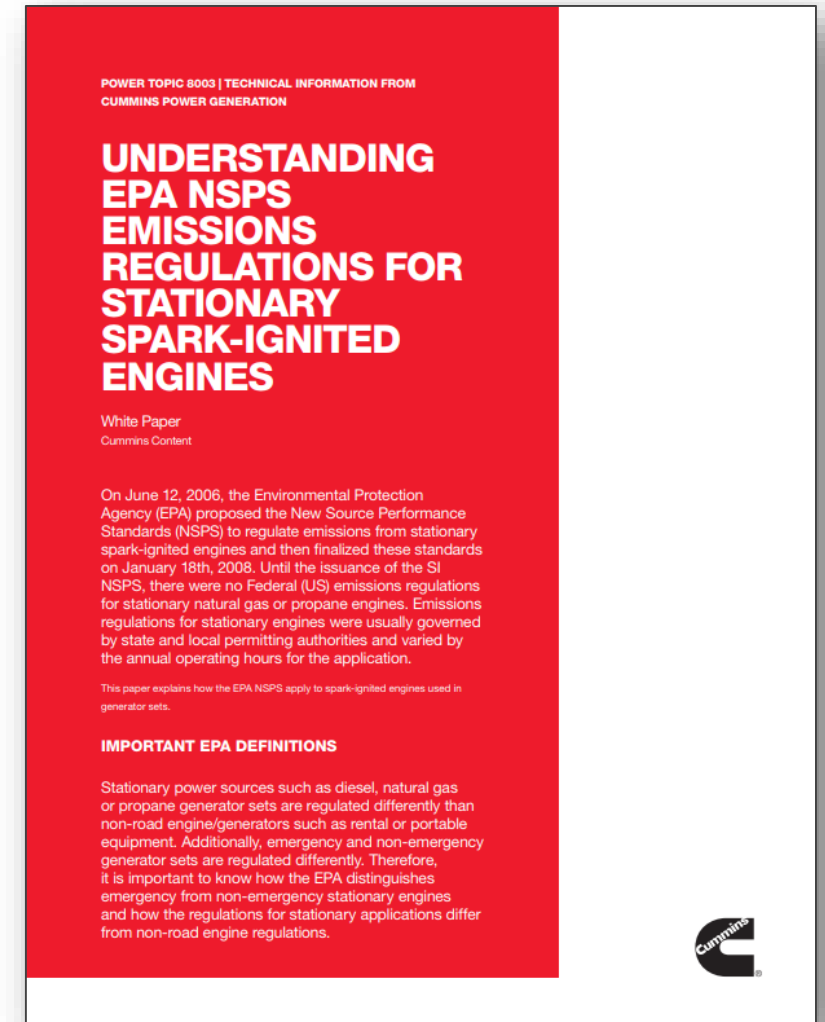
Additional Resources

Cummins White Papers

- Understanding EPA NSPS Emissions Regulations for Stationary Spark-ignited Engines
- The Latest Evolution Of Distributed Energy Resources: Opportunity For Business Within The PJM

Cummins PowerHour On-Demand Webinars

- Considerations for Specifying Generator Set Fuel Sources
- Specifying Gaseous Generator Sets
- Lean Burn Natural Gas Generator Sets in Standby-Peak Shaving Applications
- Introduction to Generator Set Sizing Software
- EPA Emissions and Air Permitting



Q&A

Please type your questions, comments and feedback in the **Zoom Q&A** window.

After the PowerHour, a complete list of questions and answers will be published on powersuite.cummins.com.



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Closing

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Upcoming PowerHour Webinars:

- Considerations for Specifying Generator Set Fuel Sources, May 20
- The Role of a System Level Control in a Power System, May 21
- Ensuring Power System Reliability through Service Specifications, June

